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U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

REPORT NO. 1137

COMBAT AIR OPERATIONS GUIDED MISSILE FUZES;  
RESEARCH, DEVELOPMENT, TESTS AND REPORTS OF

8th Partial Report

-----  
FUZING SYSTEM FOR XSAM-N-4, GUIDED MISSILE DOVE;  
STEEL PLATE IMPACT TESTS

FINAL Report

Copy No. 8

Task

Assignment NP6-Re2b-34-1-53

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NPG REPORT NO. 1137

Fuzing System for XSAM-N-4, Guided Missile Dove;  
Steel Plate Impact Tests

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PART A

SYNOPSIS

1. The XB-44A is the tail fuzing system for the warhead used on guided missile Dove. Dove is an air-to-ground, glide type of missile with stubby wings and no self-propulsion. It is approximately 24 inches in diameter and five (5) feet in length. Air scoops in the nose and stabilizing fins on the tail control the flight.
2. These initial tests of the XB-44A fuze during its evaluation phase were conducted to determine the functioning ability and delay interval after steel plate impacts.
3. The limited number of rounds fired in this test and the inconsistency of some of the results precludes the possibility of drawing any definite conclusions about the functioning ability of the fuze. The results listed below are probably indicative of the fuze sensitivity and functioning delay to be expected with the present models of the XB-44A fuze:

No. Rds.	Impact Velocity Ft./Sec.	Target		Fuze Action	Delay After Impact	
		Thickness Inches	Obl. Deg.		Distance Ft.	Time Sec.
2	375	1/4" M.S.	0	1 Dud, 1 HO	240	0.75
2	900	1/4" M.S.	0	1 Dud, 1 HO	295	0.36
1	391	1/2" M.S.	0	HO	165	0.50
1	862	1/2" STS	0	HO	125	0.29
1	900	1" STS	0	HO	220	0.40
3	900	1-1/4" STS	0	2 Duds, 1 HO	215	0.39

4. It is recommended that:

A stronger container be provided for the spotting charge used to indicate fuze action in future heavy plate penetration tests. Breakage of the container and the consequent loss of a large portion of the spotting charge resulted in the production of such small amounts of flame and smoke when the fuze detonated that observation of the action was questionable in many cases.

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PART B

INTRODUCTION

1. AUTHORITY:

Reference (a) authorized the Naval Ordnance Laboratory to deal directly with the Naval Proving Ground in conducting tests of the XB-44A fuze for the Dove missile. Reference (b) outlined the overall evaluation program for this fuze, and reference (c) those tests desired on the Naval Proving Ground's 500 ft. rocket launcher. Tests were conducted under task assignment NPG-Re2b-34-1-53, reference (d). Reference (e) requested that field testing of the fuze be suspended as a result of the unsatisfactory arming times encountered during the program.

2. REFERENCES:

- a. BUORD ltr NP9 (Re2b-286-2) FLY of 4 Apr 1949
- b. NOL ltr NP51/S71-8(3-615) TF:HLD Ser 01641 of 19 Dec 1950
- c. NPG Work Request from NOL, TSS 6125 of 31 Oct 1951
- d. BUORD Conf ltr Re2b-DBLaP:bjn Ser 42694 of 29 Jul 1952
- e. NOL ltr NP/NOL/X11 (649) Ser 0751 of 31 Mar 1952
- f. NPG Report No. 933 of 20 Mar 1952

3. BACKGROUND:

The XB-44A is the tail fuzing system for the warhead used on guided missile Dove. Dove is an air-to-ground, glide type of missile with stubby wings and no self-propulsion. It is approximately 24 inches in diameter and five (5) feet in length. Air scoops in the nose and stabilizing fins on the tail control the flight. Reference (f) describes the relatively unsatisfactory performance of the fuze during its functioning tests while in the development stage.

4. OBJECT OF TEST:

These initial tests of the XB-44A fuze during its evaluation phase were conducted to determine the functioning ability and delay interval after steel plate impacts.

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5. PERIOD OF TEST:

a. Date Project Letter	31 Oct 1951
b. Date Necessary Material Received	3 Jan 1952
c. Date Commenced Test	29 Jan 1952
d. Date Firing Stopped	6 Feb 1952
e. Date Test Suspended	31 Mar 1952

6. REPRESENTATIVES PRESENT:

H. L. Davis	Naval Ordnance Laboratory
R. Happick	Naval Ordnance Laboratory

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PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

The XB-44A is a vane arming tail fuze completely described and illustrated in reference (f). Dual primers, detonated upon impact by firing pins, initiate a pyrotechnic delay train which provides approximately one-quarter second delay before detonation of the fuze.

8. DESCRIPTION OF TEST EQUIPMENT:

Test Vehicles:	Modified 250 lb. G.P. Bombs, AN-M57A1, inert loaded except for cross axial smoke puff tube in after end of bomb immediately forward of fuze booster.
Launcher:	NPG 500 ft.
Targets:	1/4" and 1/2" mild steel; 1/2", 1"O and 1-1/4" STS.
Propulsion:	Low Velocity Impacts - one (1) 5" HVAR motor with 3"25 retro motor Mk 7
	High Velocity Impacts - three (3) HVAR motors in carriage with either 3"25 or 5"O HVAR retro-motor to separate carriage from bomb. Round 8 utilized 3 Model 38 propulsion motors.
Camera:	Bowen Acceleration at 180 frames/second.
Pre-arming of fuze:	100% Compressed Air Supply.

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9. PROCEDURE:

a. The XB-44A fuzes and black powder spotting charges were installed in 250 lb. G.P. Bombs in the manner described in reference (f). The fuzes were pre-armed while on the launcher, immediately prior to firing.

b. Round 8 was propelled by three (3) 5"0 rocket motors Model 38, installed parallel in a carrier. All other high velocity impacts utilized three (3) 5"0 HVAR motors for propulsion of the round. Separation of the propulsion carriage and bomb was obtained by the use of either a 3"25 or 5"0 "retro" motor (motor installed in carriage in reverse direction to propulsion motors). The "Retro" motor was ignited after 380 ft. of launcher travel so that the bomb and carriage would not be in contact when they left the launcher. Low velocity impacts (350-400 ft./sec.) were obtained with a single 5" HVAR motor as the propulsion vehicle and a 3"25 "retro" motor Mk 7 providing the separation force.

c. The distance from the launcher muzzle to the target was varied between 50 and 200 ft. in an attempt to establish the optimum distance for adequate separation and minimum yaw of the rounds.

d. The time and distance of fuze delay after target impact was measured with a Bowen Acceleration camera stationed normal to the line of flight on rounds 3 thru 10.

10. RESULTS AND DISCUSSION:

a. A detailed record of the test results is presented as Table I. Excerpts from the Bowen film records of target impacts and delayed fuze functioning are shown as Figures 1 thru 8.

b. A 3"25 rocket motor Mk 7 proved to be unsatisfactory as a "retro" force when used with the three (3) motor carriage on the 500 ft. launcher. If a longer launcher had been available, permitting the propulsion motors to burn out before ignition of the "retro" motor, it is possible that a 3"25 motor might have had sufficient thrust to effect sufficient separation of the round before impact. Motors having a higher acceleration and shorter burning distance (the 5"25 motors Mk 1 used with the Weapon A round have been considered) would have been more desirable than the 5" HVAR motors for propulsion. A 5" HVAR motor was used as a "retro"

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motor on the last two (2) rounds with good results. Separation was necessary to prevent damage to the tail fuze and eliminate any extra forces on the bomb during target penetration. A 3"25 "retro" motor was satisfactory for separation when a single 5" HVAR motor was used for propulsion.

c. Six (6) of the ten (10) fuzes tested functioned after target impact with delay times ranging from 0.29 to 0.75 seconds. The fuze is designed to have a delay time of 0.25 seconds. All rounds flighted into the river so that the dud fuzes could not be recovered to determine the cause of malfunctioning.

d. The sensitivity of the fuze cannot be established from the results obtained inasmuch as consistent functioning was not obtained on any of the targets employed. Two (2) of the four (4) rounds fired at the lightest target, 1/4" mild steel, resulted in high order fuze detonation; the other two (2) were duds. All three (3) rounds fired against the heaviest target, 1-1/4" STS, lost the greater part of their spotting charge upon target impact when the black powder container ruptured. Consequently, the two (2) apparent duds in these three (3) shots may have actually had satisfactory fuze functioning which could not be observed because of the lack of sufficient spotting charge material.

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PART D

CONCLUSIONS

11. a. The limited number of rounds fired in this test and the inconsistency of some of the results preclude the possibility of drawing any definite conclusions about the functioning ability of the fuze. The results listed below are probably indicative of the fuze sensitivity and functioning delay to be expected with the present models of the XB-44A fuze:

No. Rds.	Impact Velocity	Target	Col. Deg.	Fuze Action	Delay After Impact	
	Ft./Sec.	Thickness Inches			Distance Ft.	Time Sec.
2	375	1/4" M.S.	0	1 Dud, 1 HO	240	0.75
2	900	1/4" M.S.	0	1 Dud, 1 HO	295	0.36
1	391	1/2" M.S.	0	HO	165	0.50
1	862	1/2" STS	0	HO	125	0.29
1	900	1" STS	0	HO	220	0.40
3	900	1-1/4" STS	0	2 Duds, 1 HO	215	0.39

PART E

RECOMMENDATIONS

12. It is recommended that:

A stronger container be provided for the spotting charge used to indicate fuze action in future heavy plate penetration tests. Breakage of the container and the consequent loss of a large portion of the spotting charge resulted in the production of such small amounts of flame and smoke when the fuze detonated that observation of the action was sometimes questionable.

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Steel Plate Impact Tests  
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Ordnance Officer  
By direction

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U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Eighth Partial Report

on

Combat Air Operations Guided Missile Fuzes;  
Research, Development, Tests and Reports of

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Final Report

on

Fuzing System for XSAM-N-4, Guided Missile Dove;  
Steel Plate Impact Tests

Project No.: NPG-Rc2b-34-1-53  
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**Fusing System for XSAM-N-4, Guided Missile Doves;  
Steel Plate Impact Tests**

TABLE I

**XB-44A Fuse-FUNCTIONING Vs Steel Targets  
Fired from NPG 500 Ft. Launcher in 250 lb. G.P. Bombs**

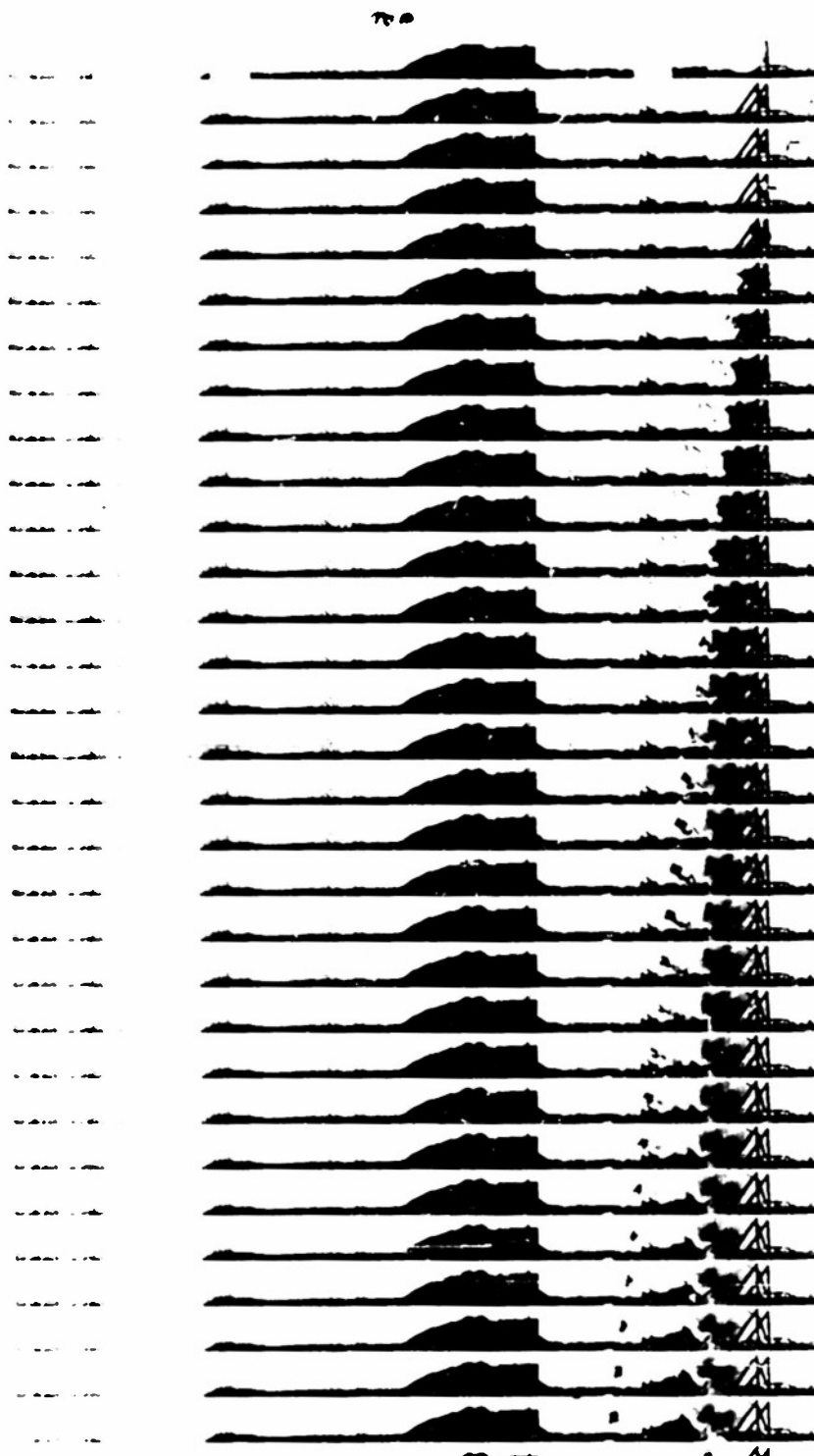
Date Fired	Rd. No.	Fuse No.	Target		Propulsion	Striking Velocity Ft./Sec.	Fuse Action	Measured Fuse Delay		
			Thickness	Obl.				Ft.	Sec.	Flight
1-29-52	1	150	1/4" M.S.	0°	1-5" HVAR	366	DUD	---	---	Good
1-29-52	2	154	1/2" M.S.	0°	1-5" HVAR	391	HO	165	0.50	Good
1-30-52	3	151	1-1/4" STS	0°	3-5" HVAR	840	DUD	---	---	90° Yaw At Impact
1-30-52	4	152	1/2" STS	0°	3-5" HVAR	862	HO	125	0.29	Slight Yaw At Impact
1-31-52	5	155	1/4" M.S.	0°	1-5" HVAR	379	HO	240	0.75	Good
1-31-52	6	156	1/4" M.S.	0°	3-5" HVAR	879	HO	295	0.36	Good
1-31-52	7	157	1/4" M.S.	0°	3-5" HVAR	950	DUD	---	---	Good
2-4-52	8	158	1-1/4" STS	0°	3-5" Model 38	988	DUD	---	---	70° Yaw At Impact
2-5-52	9	160	1-1/4" STS	0°	3-5" HVAR	861	HO	215	0.39	Good
2-6-52	10	153	1" STS	0°	3-5" HVAR	900 (Approx)	HO	220	0.40	Good

## Remarks:

- Rd. 1 No Camera  
 Rd. 2 No Camera  
 Rd. 3 Black Powder Spilled from Bomb after Impact  
 Rd. 4 Black Powder Spilled from Bomb on target impact may have been ignited by Retro Motor - Bomb hit ground 125 ft. beyond target - Fuse action uncertain but appeared probable at this point.  
 Rd. 5 Fuse Action out of camera field but was observed visually  
 Rd. 6 Fuse Action out of camera field but was observed visually  
 Rd. 7 No separation motor used  
 Rd. 8 Most of black powder appeared to spill from head after impact - may account for non-observation of fuse action  
 Rd. 9 5" HVAR Retro Motor used for separation - some Black Powder lost from bomb after impact  
 Rd. 10 5" HVAR Retro Motor used for separation - Good flight and separation on rounds 9 and 10 - Some Black Powder lost from Bomb after impact.

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APPENDIX A



NP9-63144

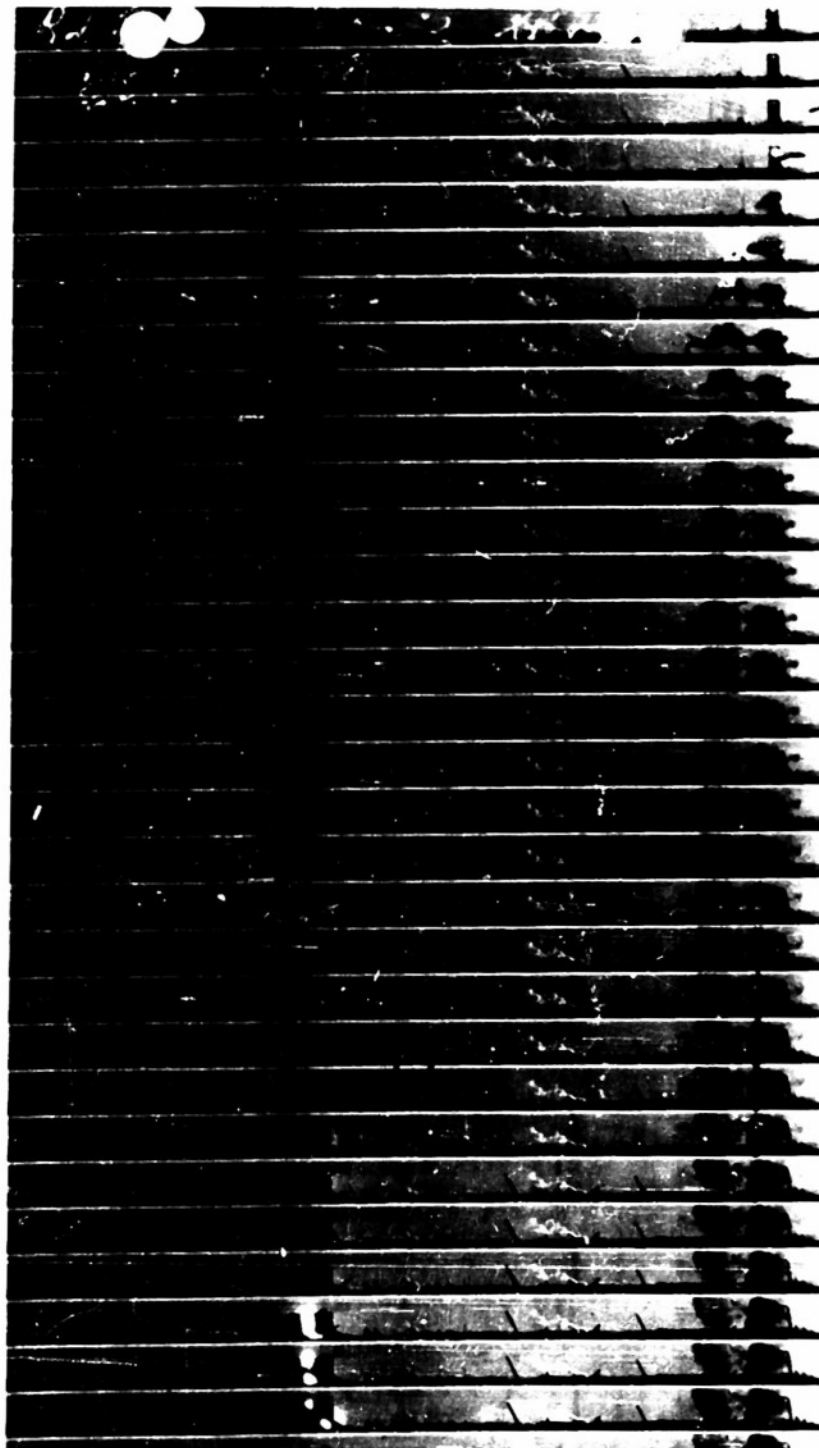
Date Fired: 30 January 1953

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Functioning Test of XB-44A Dove Fuze. View: Rd 3 - Dud operation of fuze #151 after penetration of 1-1/4" STX target, 0° chl. at 840 ft/sec. Fuze is mounted in tail of 250# C.P. bomb. Smoke at target results from deflagration of unburned propellant upon impact and spillage of black powder spotting charge.

Figure 1



N79-63145

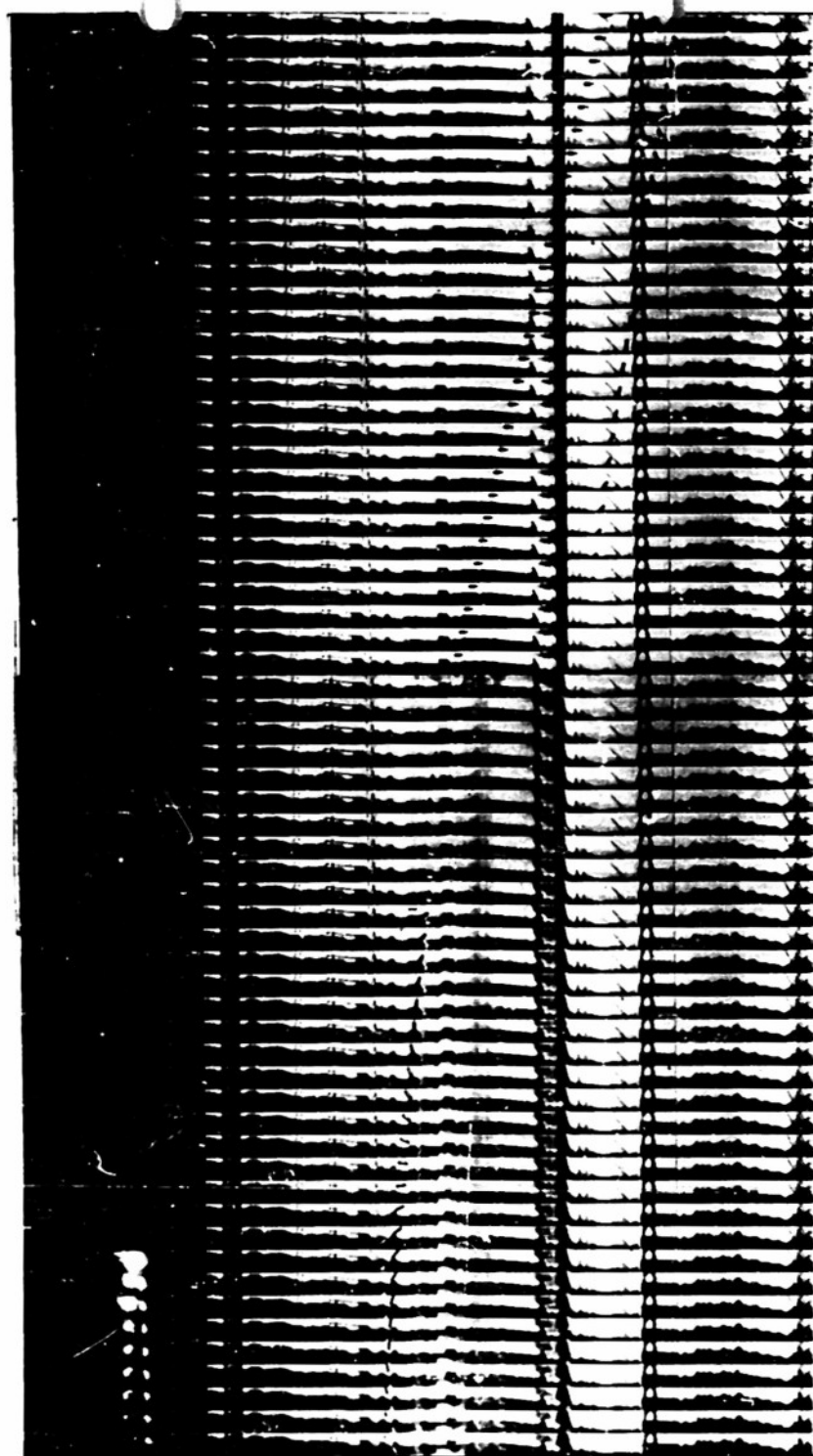
Date Fired: 30 January 1953

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Functioning Test of XB-44A Dove Fuze, View: Rd 4 - Fuze #152, operation 125 ft. (0.29 sec.) after penetration of 1/2" STS target, C° obl., at 862 ft/sec. Flash immediately behind target originates from unburned propellant in "retro" motor. Fuze spotting charge is circled.

Figure 2



WD-6146

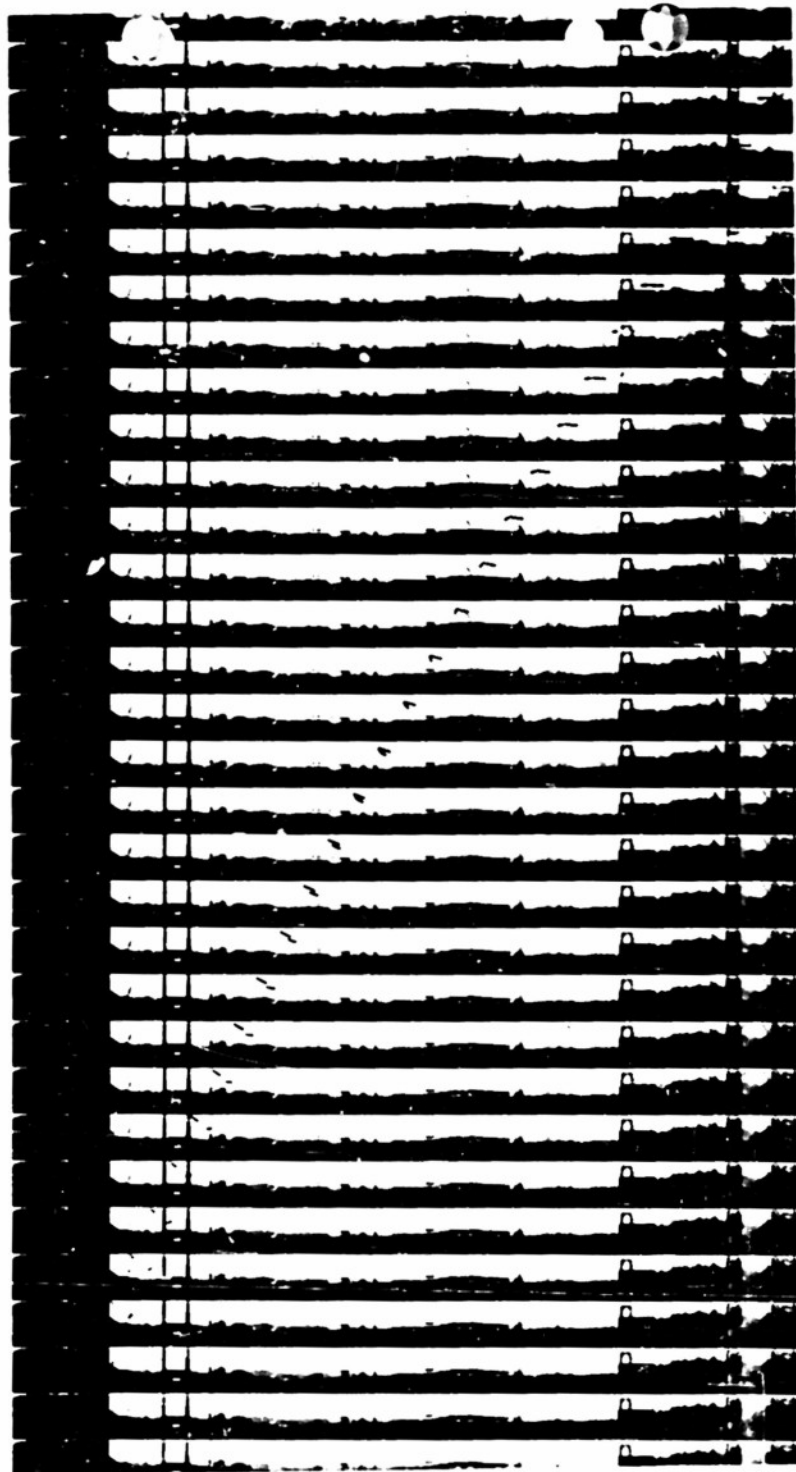
Date Filed: 31 January 1953

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Functioning Test of XB-4A Dive Fuze. View: Rd - Fuze #1's operation 240 ft.  
.75 sec.) after penetration of 1/4" mild steel target, C° obliquity at 379 ft/sec.  
Smoke puff detonated by fuze mounted in tail of 250# G.P. bomb.

Figure 3

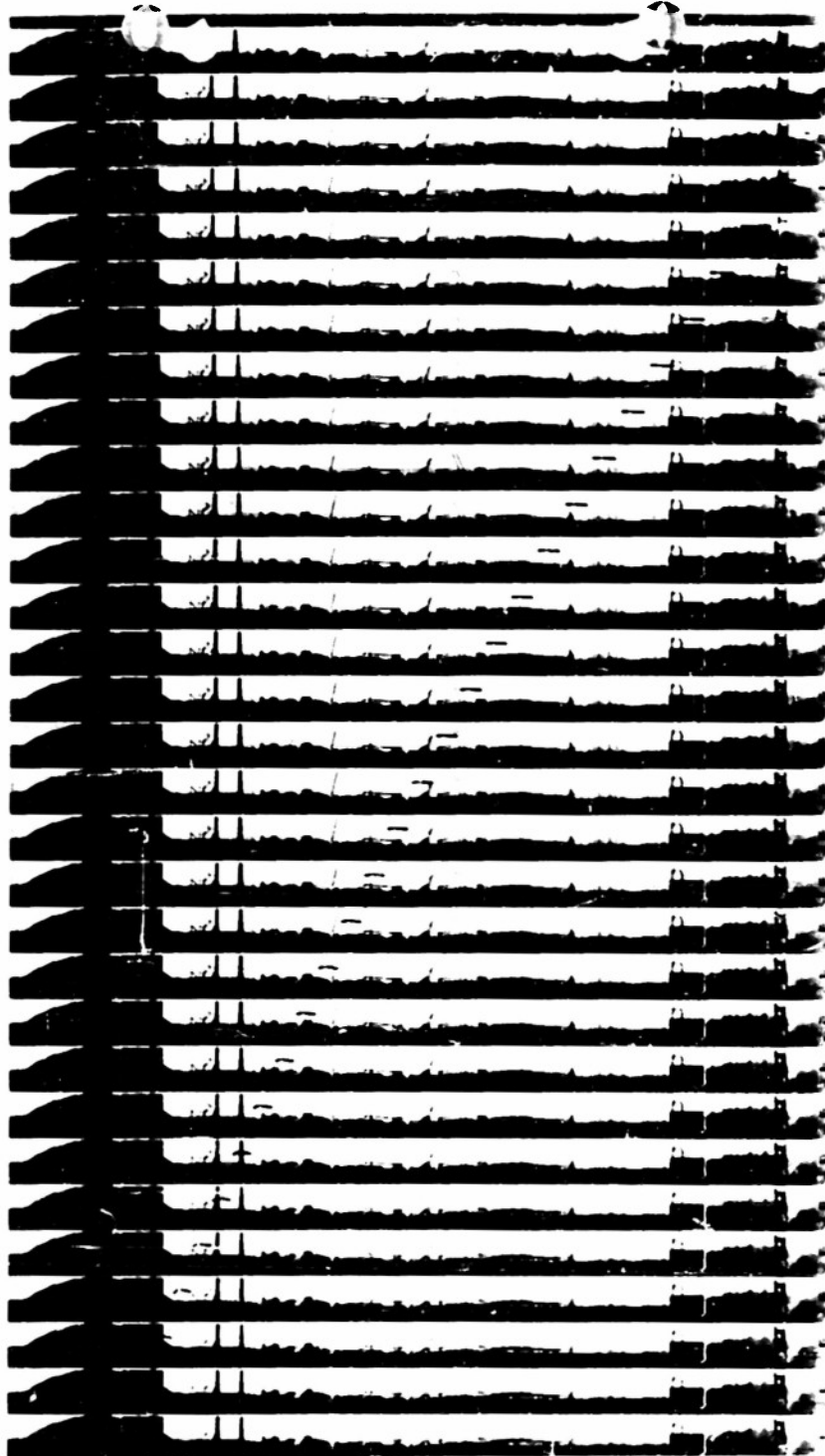




NP9-63147- Date Fired: 31 January 1953  
Functioning Test of XB-44A Dove Fuze. View: Rd 6 - Fuze #156 fired from NPG 500 ft  
launcher in 250# G.P. bomb vs 1/4" mild steel target at 0° obl. Impact velocity  
879 ft/sec. Fuze functioned H0 with 295 ft. (0.36 sec.) delay after impact, out of  
field of view of camera. Figure 4

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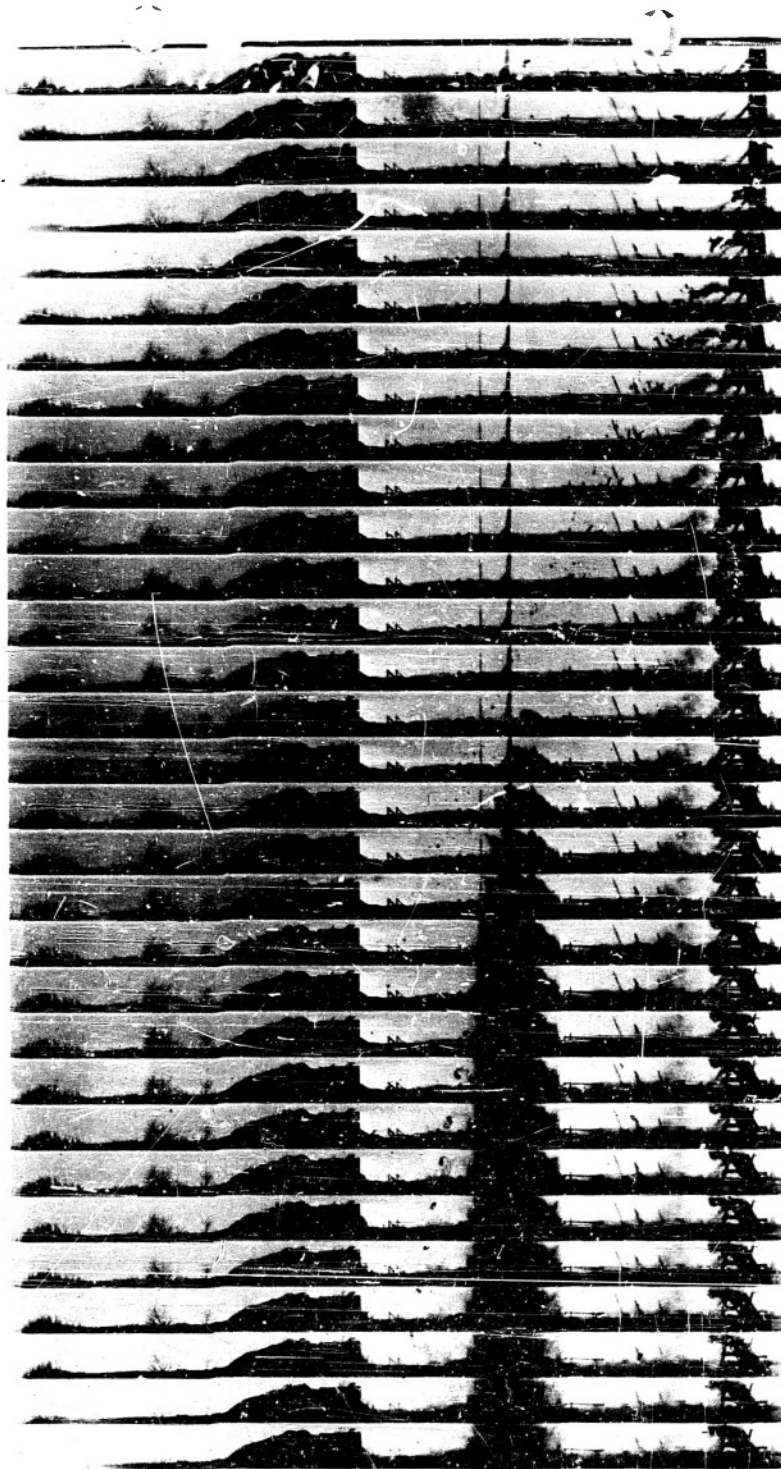
7



NP9-63148 Date Fired: 31 January 1953  
Functioning Test of XB-44A Dove Fuze. View: Rd 7 - Fuze #157 fired from NPG 500 ft.  
launcher in 250# G.P. bomb vs 1/4" mild steel target at 0° obl. Impact velocity  
950 ft/sec. Fuze did not function.

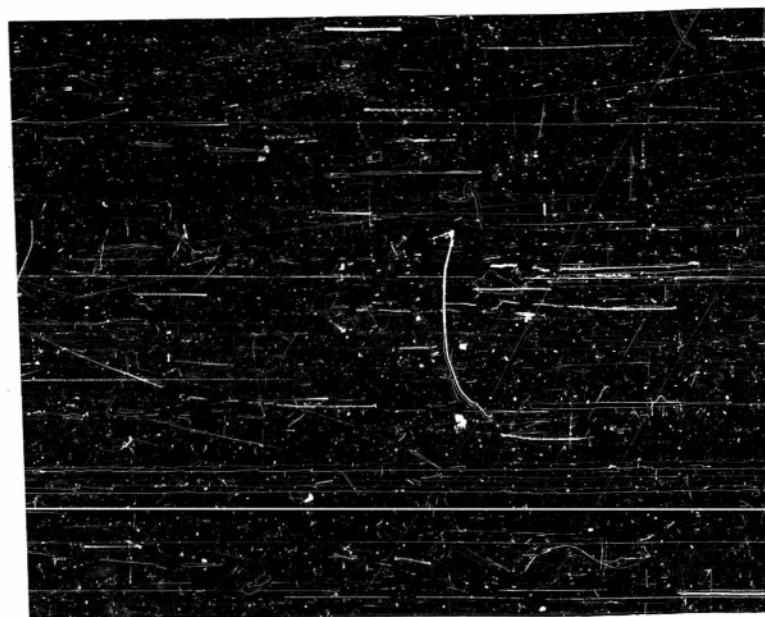
Figure 5

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NP9-63149 - Date Fired: 4 February 1953  
 Functioning Test of XB-44 dove fuze: View Rd 3 - Fuze #158 fired from NG 500 ft.  
 launcher in 2 1/4 sec. bomb ve 1-1/4" sis target at 07 061. Impact velocity 286 ft/s.  
 Black powder in charge container apparently ruptured spilling black powder after  
 target impact, possibly preventing fuze action from being visible.  
 Figure 6

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NP9-63150

Date Fired: 5 February 1953

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Functioning Test of XB-44A dove Fuze. View: Rd 9 - Fuze #160 fired from NPG 500 ft. launcher in 250# G.P. bomb vs 1-1/4" STS target at 0° obl. Impact velocity 881 ft/sec. Fuze functioned H0 with 215 ft. (0.39 sec.) delay after impact. Note fuze detonation at after end of sand pile. Figure 7

